

concentration from said first friction surface to said second non-engaging surface, said heat conducting elements transferring heat away from the first friction surface of said functionally graded material to the second non-engaging surface, said heat and wear resistant fibers increasing in concentration from said first friction surface to said second non-engaging surface.

Please rewrite claim 11 as set forth below in clean form.

11. (Three Times Amended) In a composite friction material having opposed surfaces with one surface engaging a movable, engageable part, the improvement comprising heat conducting elements disposed in said composite friction material in a selected arrangement and a varying concentration for transferring heat away from said engaging surface to a non-engaging surface, said varying concentration of said heat conducting elements decreasing in concentration from said first friction surface to said second non-engaging surface, said heat conducting elements being woven with fibers forming the composite friction material, said fibers increasing in concentration from said first friction surface to said second non-engaging surface.

Additionally, in accordance with 37 CFR 1.121(c)(1)(ii), all amended claims are set forth in marked up versions in the pages attached to this Amendment.

REMARKS

After carefully reviewing the Office Action mailed June 4, 2002, Claims 1 and 11 have been amended to more particularly define the present invention. Reconsideration of the application, as amended, is requested.

The Examiner rejected Claims 1-4, 6-12, 14, 15, 20, 21, and 23 under 35 U.S.C. §103(a) as being unpatentable over the Booher patent (U.S. Patent No. 5,156,787) in view of the Miyamoto et al. patent (U.S. Patent No. 6,001,440). The Examiner says that the Booher patent fails to teach that the heat conducting elements are situated within the functionally graded material with a varying concentration in the manner claimed, but looks to the Miyamoto et al. patent as teaching this feature.

The Applicant respectfully traverses this rejection and submits that a careful

review of the Booher patent reveals that it is only the reinforcing fibers 14 that have a controlled orientation as well as a controlled density within the resin matrix, column 2, lines 37-40. Booher explicitly teaches that heat conducting elements such as powders of graphite, copper or the like are uniformly distributed throughout the resin material to aid in the dissipation of heat, note column 2, lines 50-60. The amended claims now recite that the heat and wear resistant fibers vary in concentration wherein there is an increase in concentration from the first friction surface to the second non-engaging surface. Nowhere does the Booher patent teach or suggest such this feature, or the combination as claimed.

This portion of the Booher patent (column 2, lines 50-60) specifically teaches away from the Examiner's proposed combination with the Miyamoto et al. patent in that Miyamoto et al. teaches of using a heat conductive powder with a concentration gradient.

The Applicant respectfully submits that one of ordinary skill in this art would not look to the Miyamoto et al. patent as providing a teaching for a concentration gradient of heat conducting elements for a friction material since the Miyamoto et al. patent particularly relates to thin films suited for laser printers and electrophotographic copying machines as described in column 1 of that patent. Even though the Miyamoto et al. patent teaches of providing a concentration gradient for a heat conducting powder, the angle of concentration gradient is arbitrary (column 2, lines 50-53) and the thickness of the film (column 3, lines 30-34) is so thin that one of any skill in the friction art would not even consider the teachings of this patent. Furthermore, the Miyamoto et al. patent does not suggest increasing the concentration of the heat and wear resistant fibers as claimed.

The dependent claims contain the believed allowable subject matter of the independent claims from which they depend and serve to further define and limit the instant invention.

Regarding claims 21 and 23, even though the cited references fail to teach the claimed concentration or depths, the Examiner contends that these are obvious based on describing a film ranging in a depth of 20 to 300 microns. To assist the Examiner in better understanding this important distinction, the Applicant has converted the depths of dependent claim 23 from inches to microns, 0.05 inch equals 1,270 microns and 0.10 inches equals 2,540 microns. 20 microns is not remotely close to 1,270 microns nor is 300 microns to 2,540 microns.

If one of ordinary skill in the art were to combine the Booher patent with the Miyamoto et al. patent, in spite of their contrary teachings, one still would not arrive at the instant invention. The amended claims now recite that the heat and wear resistant fibers vary in concentration by increasing in concentration from the first friction surface to the second non-engaging surface. Basis for this feature is found on page 12, line 10 through page 13, line 5, and Figs. 3(a) - 3(b) of the subject application. A combination of the cited patents will provide a controlled orientation of reinforcing fibers (14) as taught in Booher with a heat conducting powder dispersed therein with a concentration gradient up to 300 microns as taught in Miyamoto et al. Thus, one still has not arrived at the claimed invention.

The Examiner further rejected Claims 1, 2, 4-12, 14, 20, 21 and 23 under 35 U.S.C. §103 as being unpatentable over the Shibata et al. patent (U.S. Patent No. 5,004,497) in view of the Miyamoto et al. patent.

The Examiner acknowledges that the Shibata et al. patent fails to teach that the heat conducting elements are situated within a functionally graded material in a selected orientation and spatial distribution with a varying concentration. Again, the Examiner looks to the Miyamoto et al. patent as teaching this deficiency.

The Applicant respectfully traverses this rejection for the foregoing reasons as well as the fact that the Examiner has acknowledged that Shibata et al. fails to teach an important feature of the claimed invention, i.e., a selected orientation and distribution of the heat conducting elements and the varying concentration.

The Examiner further rejected Claims 3 and 15 under 35 U.S.C. §103(a) as being unpatentable over the Shibata et al. patent in view of the Miyamoto et al. patent, and further in view of the Darfler patent. The Examiner says that the Darfler patent teaches that the effectiveness of heat transfer in a composite material having heat conducting elements depends upon orientation of the heat conducting elements.

The Applicant respectfully submits that Claims 3 and 15 contain the believed allowable subject matter of the independent claims from which they depend and are therefore also allowable since they serve further limit and define the present invention.

The Examiner also rejected Claims 13 and 22 under 35 U.S.C. §103(a) as being unpatentable over the Booher patent in view of Miyamoto et al., and further in view of the Nakamoto et al. patent. The Examiner says that the combination of Booher and Miyamoto fails to teach that copper in a composite material is a copper thread and looks to the Nakamoto patent as teaching that a woven fabric containing a

combination of synthetic yarns with a metal powder dispersed is an equivalent to woven fabric made up of metallic fibers such as copper threads and fibers other than metallic fibers for the use as a high heat diffusion material.

The Applicant respectfully traverses this rejection for the foregoing reasons as applied to Booher and Miyamoto above, and further submits that one of ordinary skill in this art would not combine the Booher patent and Miyamoto et al. as the Examiner suggests with Nakamoto et al.

The Nakamoto et al. patent (U.S. Patent No. 6,098,612) relates to a heating garment. The Applicant respectfully submits that this is not analogous art to the instant invention. As such, its consideration of what is a functional equivalent relates to the garment industry, and not to a friction material or even to a thin film polyamide material.

In view of the above, the Applicant respectfully submits that all of the claims are in condition for allowance. Reconsideration of the rejections is requested. Allowance of the claims at an early date is solicited.

Respectfully submitted,



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MARKED UP VERSION OF ALL AMENDED CLAIMS

1. (Three Times Amended) A friction material with improved wear resistance and thermal conductivity, comprising:

a functionally graded material including a composite material having heat and wear resistant fibers with a varying concentration therein impregnated with a resin; and

a plurality of heat conducting elements situated within said functionally graded material in a selected orientation and spatial distribution with a varying concentration, wherein said functionally graded material is constructed for engagement with a cooperating movable member, said functionally graded material including a first friction surface constructed for such engagement and a second non-engaging surface, said varying concentration of said heat conducting elements decreasing in concentration from said first friction surface to said second non-engaging surface, said heat conducting elements transferring heat away from the first friction surface of said functionally graded material to the second non-engaging surface, said heat and wear resistant fibers increasing in concentration from said first friction surface to said second non-engaging surface.

11. (Three Times Amended) In a composite friction material having opposed surfaces with one surface engaging a movable, engageable part, the improvement comprising heat conducting elements disposed in said composite friction material in a selected arrangement and a varying concentration for transferring heat away from said engaging surface to a non-engaging surface, said varying concentration of said heat conducting elements decreasing in concentration from said first friction surface to said second non-engaging surface, said heat conducting elements being woven with fibers forming the composite friction material, said fibers increasing in concentration from said first friction surface to said second non-engaging surface.